THE MODEL ENGINEER

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Smoke Rings

From the Lord Mayor of London

I HAVE received the following acknowledgment from the Lord Mayor of London in reference to the generous donation of £100 cabled to me by the Sydney Society of Model Engineers, for the relief of distress in the bombed areas. He writes: "I thank you for your letter of the 27th March with which you sent me cheque for £100 in aid of my National Air-Raid Distress Fund, on behalf of the Sydney Society of Model Engineers, Sydney, Australia. I was very interested to read your remarks about this Society, and wish to thank you very warmly for allocating this gift to my Fund, and for the very kind manner in which you have acknowledged the donation to your friends. I feel I would like to thank them personally for their kind and sympathetic concern for the welfare of our unfortunate air-raid victims, and I should be grateful if you would kindly convey to them the enclosed letter together with official receipt." I have had pleasure in forwarding the Lord Mayor's letter of thanks to the Sydney Society, and with it I would couple the appreciation of all model engineers in the mother country.

* * *

The Safety of Tools and Models

I HAVE on more than one occasion urged upon readers the desirability of storing valued tools and models in a safe place, if such a place is possible to find. The importance of this advice is emphasised by a letter from a Scottish reader who has just lost all his workshop equipment and the results of 20 years' model-making work, through enemy action. This is not the only instance of the destruction of a model engineer's home which has come to my notice, and since we are likely to experience more intensive air-raids in the coming months, my advice seems more than ever necessary.

* * *

The "Boys in the Back Room"

IN his recent broadcast on the development of aircraft production, Lord Beaverbrook made a striking reference to the work of the "boys in the back room." By these he meant the designers and technicians who had been responsible for so much of the improvement in aircraft construction and performance, in fact, the scientific brains of his Ministry. He mentioned two or three of these experts by name, among them Mr. W. S. Farren. This at once brought to my mind that many years ago Mr. Farren was a valued contributor to the pages of THE MODEL ENGINEER, and in particular, the author of an excellent series of articles on a vertical petrol engine of his own design, which we published in 1913. I wrote a little personal note of congratulation to Mr. Farren, and in the course of a very kindly reply, he says: "I have always felt that I owed you and THE MODEL ENGINEER a good deal. There is nothing like doing things for oneself to find out how they work, and I have always found that practical experience of how a thing works is the best way to understanding why it works and making it work better." Here is a justification of model engineering from one who has proved it in a remarkable degree. I am sure all my readers will join me in congratulating Mr. Farren on the splendid work he is doing.

* * *

Training in the Home Workshop

THE urgent demand for trained employees, both men and women, for munition factories suggests that training facilities might be extended to home workshops. While it is true that the accommodation in the home workshops is very restricted, it should be quite possible for the model engineer to establish a small rota of pupils who could attend one, or possibly two at a time, and receive instruction in elementary metal-working matters. The construction of a lathe and the simpler processes of turning could be explained, as also could be the use of measuring instruments, and the nature and purpose of the various bench and hand tools. The properties and uses of various metals could be illustrated and demonstrations could be given of such work as marking-out, soldering and brazing, and drilling. It could not be expected that such tuition would fully take the place of instruction given in the Government Training Centres, or in the factory itself, but it would form an excellent preparatory basis for the more advanced teaching the trainee would later receive, and would enable him or her to make more rapid progress. In particular, such home instruction might be most useful to the younger generation who are joining up with the air training scheme and who will require to possess some mechanical knowledge. Those model engineers who are unable to use their workshops for actual munitions production, may, in this way, find a most useful outlet for their spare time, and their enthusiasm for helping the national cause.

* * *

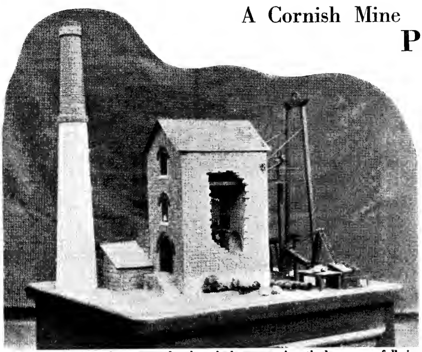
Testing a Railway Bridge

OUR Melbourne correspondent, Mr. Leo Brearley, has been good enough to send me a copy of the *Victorian Railways Magazine* for November, 1928. He was prompted to do this by my recent "Smoke Ring" on the uses of aluminium, for in that magazine, published thirteen years ago, he had contributed an interesting article on the same subject, entitled, "The Metal of the Future." In looking through the pages of this bright little publication, I found a description of the testing of a new railway bridge where four locomotives weighing 513 tons in all were run on to the separate spans, and the deflections of the bridge duly recorded by special measuring instruments. This testing of bridges is, of course, a regular practice, but the Australian event reminded me of a test which was once supposed to have been carried out in America. It is reported that the bridge, calculated to the last ounce in the stresses it would bear, stood up to the test load perfectly. But during the test, a shower of rain came on, and the bridge collapsed! This is worthy of the home of tall buildings and tall stories.

Percival Marshall

A Cornish Mine PUMPING ENGINE

By F. D. Woodall



View, showing large doorway used to drag the large parts into the house on a full-size engine.

THE writer would not describe himself as a model engineer, but would say that his interests were in minerals, mines, and old-style mining machinery. It is as part of the latter interest that this model came to be built.

A previous model Cornish engine was described in THE MODEL ENGINEER for November 4, 1937. Whilst this model did actually work with steam, it left much to be desired. The movement was too fast and jerky and was unreliable. Due to more information on the full-size engines becoming available, both from engines visited and from correspondence from Cornishmen, it became obvious that the proportions were not as good as they might have been.

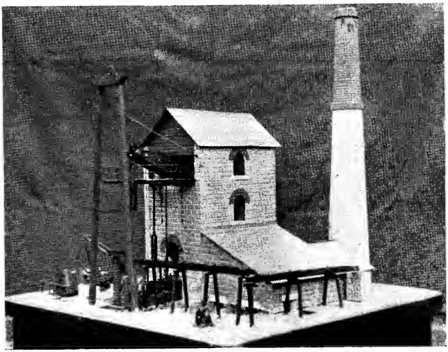
The writer has no room for historical models which do not faithfully represent the prototype, so in January, 1937, a start was made on a new model, which has subsequently replaced the former one. I do not experience great difficulty in working small, so I fixed upon a scale of 1 in. = 5 ft., this small scale making it possible to construct a short depth of shaft without the model becoming too tall.

While not being a copy of an actual engine in existence today, the model is based on an engine having a 60-in. bore by 10 ft. stroke indoors and 9 ft. in the shaft, the beam being uneven in the ratio of 10 : 9, of course. Those who have studied the Cornish engine as built by Cornishmen, find that quite rigorous rules were adopted for the proportions of one part to another. Example—the steam valve should be one-sixth of the bore, the piston-rod diameter one-tenth of the bore and length of the beam from gudgeon to nose-pin 20 inches per foot of stroke. Also, fairly constant design was used, although seldom were two engines exactly alike. These inherent features of the Cornish engine greatly helped in fixing the design of the model.

Careful observation of the working of engines in Cornwall showed that the cycle of work was (1) engine making indoor stroke; then (2) a pause for rather longer than the time to make the stroke; (3) outdoor stroke slowly at first, but with increasing speed until near the end of the stroke; (4) another pause, often longer than the indoor pause. A cam was plotted to give this movement in one revolution, the drop being 2 in. to suit the stroke of the piston-rod.

All the visible parts of the prototype are in the model, but the valves and piston do not exist; instead, the piston-rod passes through the cylinder bottom and is fixed to a weight carrying a small roller which rides on the cam. A small a.c. electric motor drives the cam at 8 r.p.m., and so the engine makes 8 double strokes per min.

As steam is not used and sticky oil is absent, it was felt that small detail work would show up more than in a conventional steam engine, so extra care was taken in both



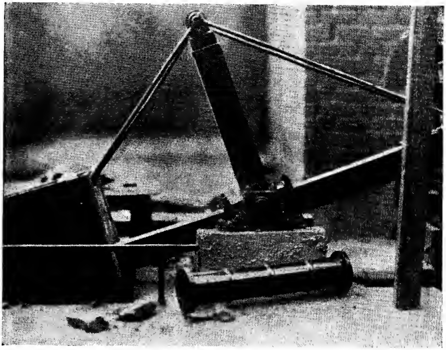
Another view, showing the winch in the foreground.

the "engineer" work and also the carpenter's work, such as steps and floors.

Like the more common rotary beam engines, the Cornish engine has parallel motion, but a feature not found on any but genuine Cornish engines is that often the nose-pins float in brass "half-bushes" in the ends of the beam. It is these and other essentially Cornish features which make it almost impossible for anyone to make a good model of one of these engines without spending a great number of hours, or even days, inspecting the engines in their native county.

The following points may be of interest. By far the largest number of nuts are 13 B.A., which is 3/64-in. dia., and nearly all the nuts are square and not hexagon, as on later-day engines. All metal work outside the house is blackened by heating, dipping in oil, and burning off; the process being repeated until a blacksmith's finish is left on the work.

In some of the photos. can be seen some lengths of large-bore pipe known as columns; these were usually cast in 9-ft. lengths. A few lengths can usually be seen near the top of the shaft on any Cornish mine, either ready for sinking the shaft and installing another lift of pumps, or else to replace any that might fracture.

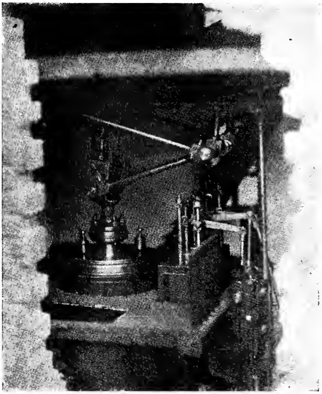


Close-up of balance bob, built of home-grown oak, and tie bolts. Length of pump column in foreground.

The building is made of oak, the windows of mica, and the roof of cardboard, with thick paper "slates" put on in strips. The base of the model is about 17 in. square.

The model will pump water, but is usually shown working without.

About three to four years ago a reader wrote to me regarding Cornish engines. I believe he was thinking of making a model, as he had just retired. He wrote to thank me for the photos. I sent him and told me he had seen engines in Cornwall years ago, when he had been mineral collecting. I should like to hear from him if he remembers me. I agree that it is a bit of a "wild-goose chase" when I don't know his name. On the other hand, only a few readers have written to me. I think he lived in the Midlands or Derbyshire.



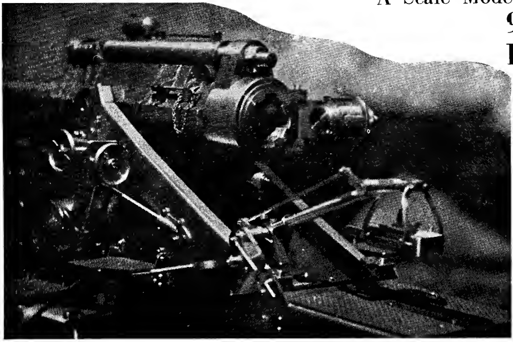
Close-up, looking into "Middle Chamber" or second storey in the engine house, showing cylinder cover, parallel motion, gearwork, etc.

A Temporary Safe-Edge for the File

There are times, when using a file, that one does not wish to have the edge of the file mar the work. Safe-edge files are specially made for the purpose, but if a suitable tool is not available, there is a simple solution to the problem which, at the same time, preserves the file's original condition.

Clean out the side of the file with the usual wire brush or file card and smear enough plastic wood composition into the file edge to prevent the teeth from functioning. Press the plastic wood well in and when dry (in a matter of minutes) lightly sandpaper along the edge to smooth it down.

After you have finished the filing job, lacquer solvent will soften the filling material, which can be cleaned out with the wire brush.—L. A. Watson.



A Scale Model 9.2 HOWITZER

By L. Hudson

THE two photos. reproduced on this page show a model 9.2 Howitzer which I have nearly completed. The gun is a scale replica of the prototype, and I have tried to employ the same metals as in the real gun. The barrel is rifled with 20 grooves; the breech is of the "Asbury" single-motion type, having a parallel breech screw of the "Welin" pattern actuated by a lever on the right side. The cutting of the breech screw was rather a fine job. The screw is steel, parallel, interrupted screw, having the circumference in twelve equal divisions, four of which are plain and the other eight screw-threaded.

The diamond pattern on the platforms was cut by hand.

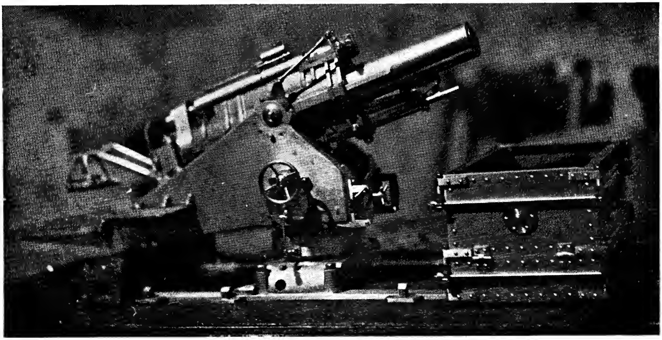
One of the most tricky jobs was cutting the skew bevels for the traversing gear, the wheels being only 5/16 in. diameter.

The principal dimensions are: Length overall, including earth box, 22 in.; width, $8\frac{1}{2}$ in.; height, $8\frac{3}{4}$ in. The barrel is 12 in. long, 11/16 in. bore, $1\frac{3}{4}$ in. diameter at breech.

There is more work in the earth box than one realises; I have had to make all the angle and channel iron: each rivet head has been polished; I have bored 688 holes in this box. The size is 8 in. long, $4\frac{1}{2}$ in. wide and 4 in. deep.

The scale is rather unusual, being 3/40ths.

The model has been made on an "Eta" lathe and a small drilling machine.



"RAINHILL"

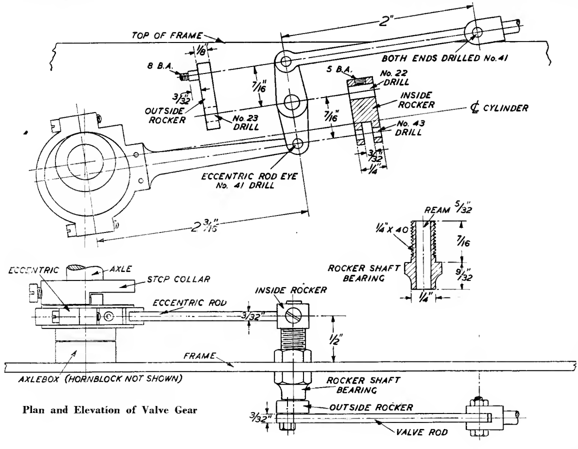
A $3\frac{1}{2}$ in. Gauge "Rocket" type Passenger-hauler

By "L.B.S.C."

SOME of the original engines had square guide bars set diagonally to the piston-rods; anybody who wishes to use them can do so with pleasure, but the easiest way, and the quickest, is to use circular bars. These are merely pieces of $\frac{1}{8}$-in. round silver steel, 2 5/16 in. long overall, with the outer ends turned down to 3/32-in. diameter for $\frac{1}{8}$-in. length. No screwing is needed. Just poke the full-size ends into the plain holes in the gland bosses on the cylinders; the reduced outer ends fit the holes in the bracket, which keeps the bars in line and prevents them coming out.

The brackets are sawn and filed to shape, from $\frac{1}{8}$-in. steel; or brass will do, as they can be painted. The lugs can be filed from odd scraps of 3/32-in. frame steel, and are roughly $\frac{1}{2}$ in. long and 5/32 in. wide. Shape of lugs, and size and position of screwholes, are shown in sketch. To attach, file a step 3/32 in. by 5/32 in. at top and bottom of the main part of the bracket, and braze in the lugs; or silver-solder if the brackets are brass.

The crossheads are about the simplest ever, and are just rectangular blocks of steel or brass $\frac{3}{8}$ in. long, $\frac{1}{2}$ in. wide and $\frac{1}{4}$ in. thickness. The holes for the guide bars are drilled through the thickness at $\frac{1}{2}$-in. centres; the 5/32-in. hole for piston-rod in the middle of one of the long ends; and the hole for the crosshead pin drilled and tapped 4 B.A. in the middle, as sketch.



Plan and Elevation of Valve Gear

Connecting-rods

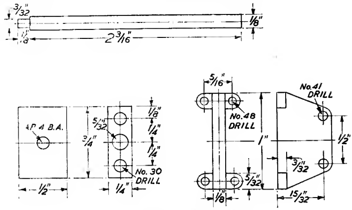
These are worth spending a little extra time over, to get the real old-fashioned flavour, as they are conspicuous. They *should* be round, and barrel-shaped, with a strapped-and-cottered big-end; but we can make a kind of compromise by using a piece of 3/16-in. by $\frac{3}{8}$-in. flat mild-steel rod, and doing a little "faking-up" on it. Cut a piece a little longer than needed, say about $4\frac{1}{2}$ in., centre both ends, and put it between the lathe centres—wouldn't that just please our old friend, Mr. Alexander! You can then turn the middle part barrel-shaped, as shown in the sketch. As the rod is 5/16-in. deep in the middle, there will be a flat place on each side; but a gentle application of a piece of emery-cloth, before removing from the lathe, will take off the sharp edges and make quite a respectable camouflage. The big-end can be filed up to the "old and crusted" outline, a bronze bush put in, and a dummy cotter put through the thickness. The little-end is a plain bushed eye, and is attached to the crosshead by a pin turned from 5/16-in. hexagon steel to a nice running-fit in the bush; the end is reduced a shade, and screwed 4 B.A. to fit the hole in the cross-head.

How to Erect Cylinders

Better take your measurements from the back end of the engine, as the cylinders are the "wrong way around." Note carefully: the centre line of the bore is 5/16 in. from the top of frame, at a point 2 7/16 in. from the back end of same. Clamp the cylinder approximately in position with a toolmaker's cramp, and pull out the piston-rod to its full extent. If it points direct at the centre of the driving axle when in running position (that is, half-way up the opening in the frame), cylinder is O.K. Test with a bit of sewing cotton stretched tight and held parallel to the centre-line of the piston-rod. If you can make countersinks on the bolting face with a long drill poked through both frames, go ahead; if not, use a bent scriber to mark on the bolting face the position of the screw-holes. The cylinders are attached with countersunk

screws, ⅛ in. or 5 B.A. as available.

Put the guide bars in the holes in cylinder covers, slip the crosshead on the bars, and put on the bracket. Hold this so as to press the guide bars home in the covers, the reduced ends of the bars fitting the holes in the bracket. Clamp the latter to the frame temporarily with a toolmaker's cramp, then fix it with four 9 B.A.s crews through the holes in the lugs. You can either drill and tap the frame, or drill clearing holes and nut the screws, having the nuts on the outside for appearance sake. The connecting-rod can then be put on. Push the piston-rod right home ; put crank on back dead centre, when the piston-rod will enter the hole



Guide bar, Crosshead, and Bracket

in the crosshead. Advance the piston-rod 1/32 in. more into the crosshead, so as to allow that much clearance between piston and cover ; then either drill a No. 51 hole clean through crosshead and piston-rod, and put in a piece of 5/64-in. silver-steel or 15-gauge spoke wire to hold the piston-rod in place, or fit a 3/32-in. setscrew, just as you fancy. The wheels should turn freely ; and when moved by hand, if you feel any tight places, find out where they are, and correct them before going any farther.

Valve Gear

This is another simple job. First of all, turn up the rocker shaft bearings to dimensions given in the detail sketch, from a piece of 5/16-in. hexagon rod ; bronze if available, but brass will do. Make two ¼-in. by 40 nuts from same kind of material, poke the bearings through the holes in frame and put the nuts on the inside, as shown in plan of gear assembly. The holes for the spindles should be reamered 5/32 in., so that the spindles fit without shake.

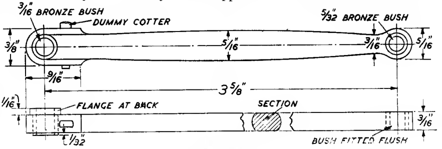
Next make the rocker arms. The outer ones are plain cranks filed up from ⅛-in. steel, and furnished with little crankpins of 3/32-in. silver-steel or 13-gauge spoke wire, pressed into No. 43 holes. Squeeze them on to 1 3/16-in. lengths of 5/32-in. silver-steel. The inner rocker arms are ¼ in. in thickness, slotted at the narrow end to take 3/32-in. eccentric-rods, and have setscrews in the wider end, to allow for adjustment when setting valves. The eccentric straps and rods are similar to that on the pump, and the distance between centre of strap and centre of eye is 2 3/16-in. The eyes may be hardened. To assemble, put the eye of the eccentric-rod in the slot in the rocker-arm, and squeeze in a piece of 3/32-in. silver-steel or 13-gauge spoke wire ; put the eccentric strap on the tumbler, hold the rocker-arm up to the bearing, and poke the spindle, with outer arm attached, through the lot, setting the two arms exactly opposite, as sketch. Simple, isn't it ? Now file up the two valve-rods from 3/32-in. flat steel, harden tne eyes, and couple up ; the front end goes over the pin in the outer rocker-arm, and the back end in the valve fork, the pin for same being a bit of 3/32-in. silver-steel or 13-gauge spoke wire nutted both ends. There is your valve gear "all-present-and-correct-sergeant" ; and yet some folk get into a terrible tangle over valve gears !

How to Set the Valves

I usually set mine under pressure, without looking at them at all ; but for novices and inexperienced workers, they had best be set by sight. Take off the chest covers ; and with the stop collars set in any position, turn the wheels by hand, and watch the valves. If they do not uncover the ports an equal amount at each end of the travel, all you have to do is to adjust the inner rocker-arms by means of the setscrew, until they do so. When the right position is found, drill a No. 51 hole through rocker and spindle, and squeeze in a bit of 15-gauge spoke wire, so that it cannot shift any more.

Now put the main crank on back dead-centre. Turn the stop collar one complete turn in the forward direction, so as to make certain the shoulder is engaging the stop-pin properly ; then continue turning slowly, watching the valve meanwhile. As soon as the black line of the port edge appears at the lap of the valve, tighten the setscrew in the stop collar. Then turn the wheels in a forward direction until the main crank is on front dead-centre, when the port should just be showing at the other end of the valve. If it isn't, the valve is too long ; file a tiny bit off *both* ends, and repeat the ceremony, until both lead openings are equal.

Now turn the wheels backwards, and watch the valve. The ports should have the same lead on both centres. If the opening does not show until after the crank has passed dead-centre, the shoulder on the stop collar is cut back too far ; a little bit of brass soldered on the contact face will soon put matters right. If the port starts to open before dead-centre, the shoulder has not been cut back far enough ; and a judicious application of a small chisel will do the



Connecting-rod.

needful, and save the trouble of pulling the whole issue apart and filing the collar. When the ports crack equally on both centres in both directions, the valve setting is O.K. ; and the little "Ancient Lights" will scoot along the track in a manner that would probably have caused her dignified big sisters of the L. and M. days to regard her as an extremely fast hussy. Superheating will also help to make her "hot stuff !" Well, that completes the "works" ; all we need now is a suitable boiler, and you will know all about that next week, if all is well.

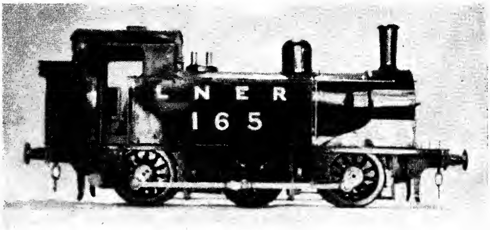
Epilogue on the "Owl"

I thought somehow that the bundle of "watch-works" between the frames of the tiny "Owl" would be as much as the average locomotive-builder would want to tackle, and a shade *too* much for unskilled workers, however confidently

(*Continued on page 308*)

A $3\frac{1}{2}$ in. Gauge Model TANK LOCO.

By W. Shearman



Side view of the finished model.

THE prototype of this model is the L.N.E. Railway (ex-N.E.R.) 0-6-0 tank loco. of the J 72 class, of which large numbers are running on the L.N.E. system.

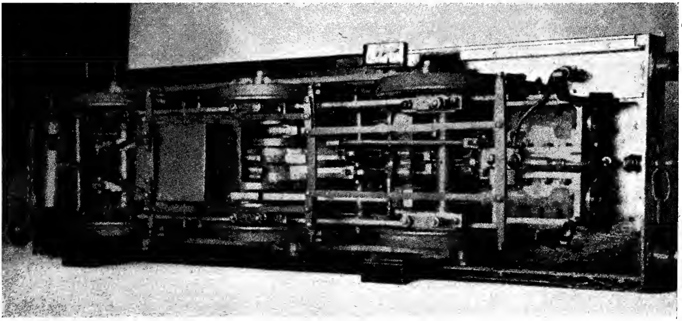
The writer got out the drawings, and with the help of his father built the model in a little over nine months of spare time work. The only castings used were wheels and cylinders; the horn-blocks being cut from $\frac{1}{4}$-in. thick steel plate, and the axleboxes are of gunmetal and are split horizontally, being fitted with oil pads. The crank-axle is built up, and turned all over after brazing. It is screwed together at the centre so as to facilitate the fitting and setting of the four eccentrics, and finally secured by a pin.

The cylinder patterns were made by the writer's father and cast locally; the wheels being cast from a tender wheel pattern (to which crank-boss was added), lent by a friend, the boss being removed later and pattern returned to its owner none the worse. These wheels were cast by Messrs. Stuart Turner; and nice stuff too.

The gunmetal cylinders were bored blind, i.e., with back covers and glands solid with them. Single slide bars are fitted; and, owing to lack of room, both valve-spindles pass through one studded gland.

When the motion was erected, we began to realise we were not in "clover," there being no room for pumps apparent! To overcome this difficulty the boiler back-head was put forward about $\frac{3}{8}$ in. to make room for two eccentrics on the rear axle. To make these as small as possible, the axle was grooved and split sheaves fitted; even then only 1/16 in. clearance obtains between these eccentrics, the firebox and big-ends. To keep the all-clear appearance at the trailing end, the pumps were placed at the top of the frame, close to the rear beam, and inclined towards the axle.

The boiler is built of copper in the usual way, and is all brazed. A combined regulator and blower-valve, whistle-valve, steam and water gauges are fitted, together with two "Ross" safety-valves. Side-clacks are fitted on the barrel. The smokebox was made from a piece of old shell case and

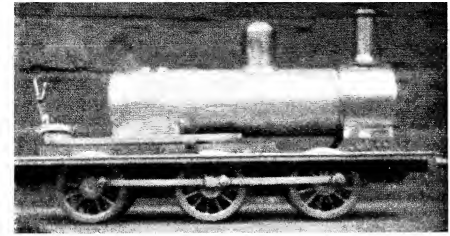


A view of the loco. from the pit.

had to be turned parallel, as these are taper inside and out. A ring-blower is fitted.

The cab and tanks are of 18-gauge hard-rolled brass. Tanks and bunker hold water, a hand-pump being fitted in the right-hand tank. To render driving and firing easy, the centre of the cab roof and rear spectacle-plate are arranged to slide out.

A mechanical lubricator on the footplate could not be made small enough to look neat, so an oscillating-type was fitted under the cylinders and takes oil from the right-hand "sandbox" via a 3/32-in. pipe. After tuning up, the model ran excellently with two up, maintaining 100 lb. against pumps, but, alas, 30 ft. of track is no racing ground!



The boiler being tried in place.

A slight increase in length of frames at the front end to accommodate the cylinders and higher tanks, together with ¼ in. over-scale boiler, are the only divergences from scale.

Here are the leading dimensions:—Cylinders (two), ⅞ in. × 1½ in. (valves between type); valve-gear, Stephenson's, with launch links; coupled wheels, 3 1/16 in. dia. (no balance weights); feed pumps (two), 5/16 in. × 5/16 in.; boiler, 3¼ in. dia., seven ⅜-in. and one ⅝-in. tubes, one ¼-in. superheater element (spearhead); firebox, 2⅛ in. × 2½ in. × 2 in. deep below firehole, fitted with steel plate "brick arch"; overall length of model, 23¾ in.; ¾-in. scale; gauge, 3½ in.

"L.B.S.C."

(Continued from page 306)

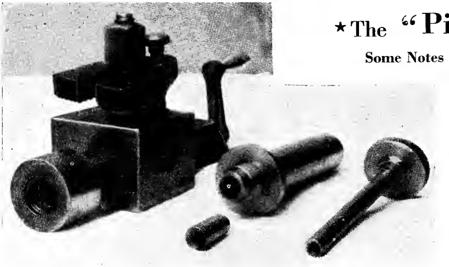
they set about the job. Just like many other jobs of similar nature, it appeals to those who love making little twiddly-bits and fitting them together; one reader told me in his letter that the drawing of the baby cylinder block so intrigued him that he made a start on it right away! However, there is an easy way out for anybody who is building the little goods engine, but is chary of tackling the cylinders and motion as already described, and that is, to fit a single inside cylinder with loose eccentric valve gear; and in response to queries, here is a brief description of the alterations, no drawings being necessary. Follow carefully and you will have no trouble.

The cylinder is made from a block of bronze or gunmetal, ⅞ in. long, ¾ in. wide and 9/16 in. thickness. On one end of the block, draw a line lengthwise, ¼ in. from one side. Make a centre-pop in the middle of it; chuck the block in the four-jaw so that the pop runs truly, drill the block right through with a 23/64-in. drill, ream it ⅜ in., and there is your cylinder. Mark out the ports on the side of the block farthest away from the cylinder bore, and cut them and drill passageways just as described for one side of the twin-cylinder outfit. Covers can be the same also.

The steam-chest is a block of bronze, gunmetal or brass, same length and width as the cylinder, but only ¼ in. in thickness, so that when it is attached to the cylinder, the combined thickness will just fill the space between frames. A recess 9/16 in. long, ⅜ in. wide, and 3/16 in. full deep, is end-milled out in the centre of this block, and a gland and stuffing-box similar to those on the "twin," fitted to one end of it. The slide-valve and spindle are the same, except that the slide-valve is made a bare 3/16 in. high instead of 7/32 in. as on the "twin." The steam-chest is fixed to the cylinder by four 9 B.A. countersunk screws, one in each corner, and the whole issue erected in the frames, as given for the "twin." The single guide bar, crosshead and connecting-rod are also as described.

The crank-axle has one crank only, set ⅜ in. from the wheel seat shoulder, to the centre of the crankpin measured between the webs, which can be 3/32 in. thickness. Alongside this, fit a loose eccentric and stop collar as described for "Rainhill," but half the size; no side flanges are needed for the eccentric, as the crank web and stop collar prevent the strap from coming off, and no boss is needed on the tumbler, which goes next the crank web. To get down to rock-bottom simplicity, the eccentric strap may be a ring of metal fitting over the tumbler, and put on before mounting to take an eccentric-rod of 1/16- in.silver-steel or 16-gauge spoke wire. The other end of this rod can either be flattened to fit the fork on the valve spindle, or have a little brass washer 3/16 in. diameter and 1/16 in. thickness, silver-soldered to it, and drilled No. 48 for the pin attaching the eccentric-rod direct to the valve fork.

Drill a hole in the steam-chest wall, on top, and screw the steam connection, already described, directly into it. Drill the exhaust-way from the upper side of the cylinder block, direct into the exhaust port, and screw in a short piece of 5/32-in. copper tube to act as blastpipe, bending same to come under the middle of the chimney, and fitting a cap to it with a 1/16-in. hole, which can be enlarged if the blast is found to be too fierce. The valve can be set by sight, if the steam-chest is removed, the cylinder temporarily replaced, and the valve put in position and connected up. Follow the directions given for "Rainhill"; and when the eccentric-rod has been adjusted to correct length by screwing the end in or out of the eccentric strap, and the stop collar set properly, simply take out the valve-fork pin, replace steam-chest with the valve inside it, and couple up again. As neither eccentric-rod nor stop collar will have been altered, the setting will remain as adjusted, and the engine should work O.K. The power will, of course, be much less than the two-cylinder version, a little more than half; and if the engine stops with the crank on either dead-centre, or after the valve has closed the ports, she will need a push to make a fresh start.



★The "Pittler" Lathe

Some Notes on its Special Features

By Geo. Gentry

Fig. 26. Special Pittler top slide (left-hand) with chuck adapter socket and hollow mandrel replica (centre) to adapt to the saddle socket and its worm drive.

The Overhead

THE writer has received quite a few letters, principally from Pittler owners, relating to its general details, and in particular to the overhead, for all of which he is indebted, and hereby acknowledges with thanks. Among these, a communication from Mr. B. H. Wainwright of Messrs. Thomas Wainwright & Sons, Engineers, of Stalybridge, is of particular interest, as it encloses a photo copy print of the complete details of the overhead directly from the drawing designs of the late Geo. Adams. The drawings, as a whole, are substantially as have been made by the writer, but not perhaps quite so detailed in some particulars. None the less, it may be that certain interested readers may like a copy, and, if sufficient enquiries are received, and Mr. Wainwright raises no objection, the writer will consider the possibility of producing a blue print.

A Special Accessory

Fig. 26, with this instalment, is a photo taken by the writer of a very special bit of Pittler equipment, which lately was in the possession of Mr. J. C. Brown, of Bowes Park. Why so described, is that no Pittler fan yet consulted can recognise it as having been seen on any other lathe or described in any of the lists or other booklets produced either by Pittler, or later, by Adams. In the centre of the picture is a compound replica of two parts of the lathe. These are, first, the pivot stalk of the regular top slide, which normally is permanently fixed at right-angles to the front underside of that slide, being made solid, and of such length to take a worm-operated worm wheel (as described for ball turning); then in the second place, it is made hollow and fitted in front with a replica of the lathe nose and its collar shoulder, and carries, therewith, the taper collet bush (seen in front) and the draw spindle to match (seen to the right). This part of the contrivance then can be equipped with any chuck fitted to the lathe, and with any work set up in the same, and so planted in the saddle socket, of course, in place of the regular top slide. Here it may either be clamped for drilling diametrically through the work, or set for milling a slight flat or similar operation. Then again, if equipped with the ball turning worm traverse, part circular slot or slab milling can be accomplished, and, if the worm spindle be adapted for division work by a plate or dial, very accurate circular division drilling can be done on turned work, such as the planting of pin teeth on pinions or chain sprockets.

This is not all, however. To the left of the picture is yet another replica, and of the top slide, but without its right-angle stalk. In place of the same is mounted, permanently, a chuck adapter socket, set in axial line with its traverse screw. This can be screwed to the lathe nose proper, or to the false nose of the pivot stalk set up in saddle socket. It there forms the equivalent of a vertical slide, not necessarily vertical to the lathe, but vertical to the position of the absent cross top slide. So long as suitable-shaped work is clamped under the tool clamp and set in parallel alignment with the slideway, it is only necessary to swing the saddle ring over to bring the work opposite the appropriate milling cutter running in the lathe, and slot milling can be done under more stable conditions than by the same job set up on the vertical slide on the tool-plate or tool post of the ordinary top slide. From consideration of this one attachment only, the appropriateness of the term "universal" as applied to the Pittler is shown to be merited, especially when it is realised that with suitable parting tools set up on this same slide, when mounted on the lathe nose proper, renders it possible to cut large circular grooves, or, with pointed tools, to mill large flat surfaces traversed across it by means of the special compound slide rest, which has a long cross traverse. So one can add operation to operation on this tool, but it is doubtful whether the originator of this accessory ever intended it to be used in the last-mentioned manner.

The Auto Power Feed

This is what Mr. Adams called the appliance, which was more simply described by Pittler himself as a "simple driving of the lead screw." Curiously enough, neither of them priced the attachment, which was undoubtedly an extra, in their lists, for the writer has only seen about two Pittlers with it on. The writer has gone to some trouble to give scale sketches of the gear, which is a worm and wheel drive fitted to the tail end of lead screw, which drive can either be operated by independent belt action from the overhead or countershaft, or by hand. It further can be equipped with a fixed dividing plate and index handle, so that minute dividing can be done by the lead screw, or more spacious dividing done to the same minute limits by the addition of worm revolutions. It happens that an old friend of the paper, who owns an almost historic example of the Pittler, so far as its adaptation to first-class model engineering can be regarded as history, has written the writer pointing out that this lathe is without the worm driven feed, as illustrated on Mr. Brown's, in Fig. 20, at the bottom right-hand corner. He has asked that, if possible, this gear should be given in detail, so that it can be added, and that the original design, as adapted by Adams (which is that shown in Fig. 20), would be preferable. This, of

* *Continued from page 111, "M.E.," February 6. 1941.*

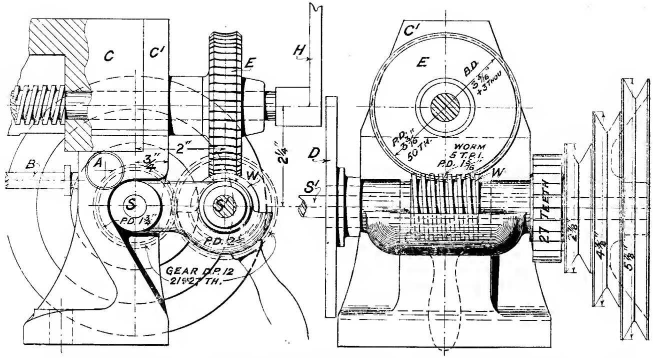


Fig. 27. Auto-power feed on lead screw tail, as given for the 5-in. Pittler. Reproduced approximately 8 inches to the foot for the $3\frac{1}{2}$-in. Pittler.

course, is a pleasing proposition, and the writer would be delighted if any B2 $3\frac{1}{2}$ in. owners, having this gear, would be good enough to help in this matter (close-up photographs would do), giving all main dimensions, as given in the accompanying drawing Fig. 27. This is the nearest thing the writer can give, and it is copied and largely developed from a small drawing of the 5-in. Pittler, published by Adams in 1904. As a whole, the drawing is modelled on what can be seen and remembered of Mr. Brown's lathe, but as he no longer owns it, the detail cannot be checked. As reproduced from a full-size setting out on the 5-in. proportions, it scales closely to the B2 $3\frac{1}{2}$ in. by means of a scale of 8 inches to the foot or 2/3rds full size for that lathe. In this gear, as fitted by Pittler in the older lathes, the driven cone pulley was on the worm shaft at the back of the lathe. In this case, the tension on the belt drive pulled the worm gear into tight mesh, but in later machines, as in Fig. 20, the pulley, with a pinion, rode on a parallel shaft, which was coincident with the swing centre upon which the worm carrier swung into or out of gear with the wheel, and was geared down to a small spur on the worm shaft.

In Fig. 27 two views are given, that to the left-hand a front view, as shown by Adams, with a developed end view to the right, in both of which all dimensions and particulars refer to the 5 in. lathe. The swing centre, marked S, is through the end portion of the tail foot bracket, which is nutted to bossed faces on the tool tray of the lathe. This centre is set in $\frac{3}{4}$ in. from the extreme end of lathe, which is a trapezoidal shaped flange, and part of the bracket C^1, which is screwed to the bed end C. Otherwise it is $2\frac{1}{4}$ in. centres below the lead screw centre. Two bossed arms of the worm bracket are housed in $\frac{7}{8}$ in. deep niches, and swing the bracket, which carries the worm W on the centre S^1 2 in. radius from the other. This centre S^1 is therefore 2 in.—$\frac{3}{4}$ in. $= 1\frac{1}{4}$ in. from the lathe end, and it is at this point that the extension of the lead screw tail jonrnal carries the centre of the worm wheel E. By swinging the bracket down something over $\frac{1}{8}$ in., the worm is held out of wheel mesh and the screw is left free to be operated by the handle H on its extreme extension. On the extension of the fixed centre shaft S at the back of lathe runs the 3-speed cone, having diameters $2\frac{7}{8}$ in., $4\frac{3}{8}$ in., and $5\frac{7}{8}$ in., and carrying on its inside a pinion of 21, 12-pitch, or 28, 16-pitch, on a pitch diameter of $1\frac{3}{4}$ in. This pinion gears to a small spur of 27, 12-pitch, or 36, 16-pitch on the inside end of worm shaft. This gear remains in gear mesh however the worm gears with its wheel. The worm bracket is in the form of a boat-shaped casting, carrying the worm in a grease bath. This boat, or cradle, is cast in one with bearing bosses at each end, from which bosses, and on the inside, project the bossed arms, which are cast on. The handle, seen screwed to a boss on underside of bracket, serves to operate the same up into worm mesh by a spring action, which, in some way, is controlled by the button A on the foot bracket. This portion of the gear is somewhat obscure in action, but it is known to be further controlled by the relase shaft B, which is a feature of the later Pittler lathes. This shaft runs the entire length of the lathe at the position shown, and passes through a clearance in bottom of saddle. It has an adjustable stop piece, which can be so placed that, at a determined position of the traversing saddle, it is caught by the same and carried along, so that the head end of B puts out the main clutch in the headstock and stops the screw at that end. Its operation at the tail is so adjusted that the movement to the left puts out the button A, releases the bracket, which is thrown out by spring action, and stops the screw. It may be that the details of this gear will be forthcoming later.

As to the worm gear of the 5 in. lathe. This, if of 50 to 1 ratio, as is the $3\frac{1}{2}$ in. lathe, will have the 50 teeth cut on a pitch diameter of 3 3/16 in., and a consequent blank diameter of 3 5/16 in. full (3 thou. over). These dimensions

(*Continued on page* 312)

*A CAPSTAN ATTACHMENT for Small Lathes

A device for the expeditious and accurate quantity production of small turned parts in the home workshop

By "Ned"

THE precise dimensions of the various components, which will be illustrated in detail, may have to be varied to suit the size or type of lathe to which the attachment is to be fitted, or the stock material available for constructing it. For instance, although the sections of rectangular bar stock selected for the slide crossbars are believed to be the most suitable for the purpose, there is no objection to the use of sections differing in width and depth if these are not available, so long as the difference is allowed for, and the desired results are achieved. The dimensions in respect of essential heights, widths, etc., of the complete assembly are correct for the 3 in. lathe owned by the writer, which is of a type very popular among model engineers; but in the event of the sizes being modified to suit other lathes, it is most important that matters should be arranged so that the centre of the capstan head sockets coincides, both vertically and horizontally, with the axis of the lathe centres. The exact alignment of these sockets, assuming that general dimensions are properly adapted, will be ensured by the methods to be described for machining the capstan head.

Slide Frame

This embodies the two cross-bars with their gibs (Fig. 3) and two 11-inch lengths of dead straight (preferably precision-ground) mild steel bar, ½ in. diam. The ordinary commercial quality of bright cold-drawn bar may, however, be used, provided that it is ascertained to be perfectly straight, circular, uniform in diameter within 0.001 in., and free from roughness.

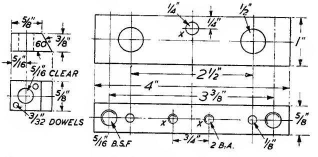


Fig. 3. Slide frame cross-bars (2 off), and clamping gibs (4 off).

The cross-bars should be cut from rectangular bar stock and trued up dead square on the ends, also checked up for general truth on all faces, and if necessary corrected by filing and scraping. As the capstan slide cross-bars have to be dealt with in a very similar way, they may be cut and trued up at the same time. One face and one edge of each bar should be plainly marked so that no confusion subsequently arises as to which is intended to be front and back, or top and bottom, just in case of any discrepancies, which should not arise, but often do.

The slide frame cross-bars should now be drilled and tapped to take the clamping gibs, and the latter cut to the dimensions shown in Fig. 3. It will be seen that the latter are drilled to take 3/32 in. dowel pins, a precaution which is strongly recommended in view of the tendency of the gibs to twist round when the single bolt, by which they are attached, is tightened up. This would result in the gib jamming rather than tightening properly against the vees of the bed, and entail a risk of damaging the latter. The 60-degree edge of the gib should be carefully fitted to provide a good bearing surface, and the position of opposing gibs should be arranged so that they grip the bed firmly when both bolts are fully tightened. A large gap between the gib and the underside of the cross-bar is very undesirable, as it causes the gib to cant and impairs the bearing against the bed, besides tending to bend the bolt. One of the gibs on each cross-bar—preferably that at the front—may be kept permanently tightened up, or even riveted to the cross-bar (when once the frame is completed), the other being tightened or lossened for attaching or detaching the appliance from the bed of the lathe. In some lathes it may be found that there is insufficient clearance between the saddle apron and the bed to allow of using gibs of the thickness shown, or projecting boltheads. In this case, it is permissible to use thinner gibs at the front of the bars, and to attach them by countersunk screws.

The next and most important job on the cross-bars is the drilling of the holes to receive the slide bars. In order to ensure smoothness and accuracy in the working of the slide, it is, above all things, most essential that these holes should be exactly the same distance apart in all four of the cross-bars, also the same distance from the reference face of each bar and square with the sides in both planes. There are several ways in which this job might be tackled, and the

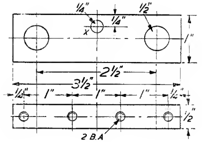


Fig. 4. Capstan slide cross-bars (2 off).

most obvious way seems to be to clamp or sweat all four of the bars together and drill them all at once. But as this method entails drilling through 2¼ in. of solid matter, it is quite possible that errors may occur through the drill running to one side, especially if the work is carried out in a drilling machine. Some constructors may prefer to drill the bars in the lathe, by clamping them on the cross slide and running the drill in the chuck. The spacing of the holes could then be ensured by traversing the slide a fixed distance (in this case 2½ in.) without dismounting the bar. This would be quite a workmanlike method if a large lathe were available, and, by fixing up some kind of a traversing stop, it would be possible to deal separately with

* *Continued from page 284, "M.E.," April 10, 1941.*

the bars without risk of error in the spacing. But if only a small lathe is available, it will not be possible to traverse the slide the required distance without a risk that its rigidity or parallelism may be dubious at one end or other of the traverse.

After due consideration, a method of carrying out this operation has been decided upon, which enables all the required conditions of accuracy to be obtained without question, and has the further advantage that, as the work is swung on the lathe faceplate, any tendency of the drill to run out of truth is immediately apparent, and can be corrected by boring if necessary ; also control of the size of the hole may readily be obtained. A rather interesting feature of this method is that although the bars are located by the end faces, it is by no means necessary to make them all the same length to ensure accuracy.

The first step in this process is to make a gauge, of a length corresponding to the required centre distance of the holes. It is not necessary, in the present case, to observe meticulous care in measuring the length of the gauge, as slight errors do not matter so long as they are the same for each bar. The gauge may be made by facing and slightly rounding the ends of a piece of mild steel rod.

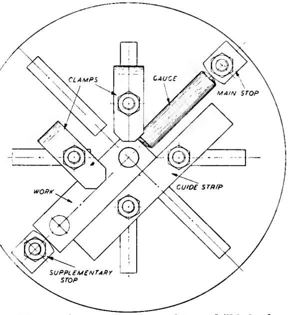


Fig. 5. Method of setting up the cross-bars to drill holes for slide bars.

The work is then roughly marked out to show the position of the holes, and set up on the faceplate so that one of the hole centres run truly. A dead straight strip of metal is then clamped to the faceplate in contact with the edge of the work, and an end stop also rigged to make contact with the end of the work furthest from the centre. This stop is not, strictly speaking, a necessity, but is useful because centrifugal force tends to throw the work to the edge of the plate when the lathe is running, and this is definitely prevented by placing a stop at the outer end.

Another end stop is now fitted opposite to the first, and at such a distance that the gauge will just fit between it and the end of the work. It is necessary to adjust the distance very finely, so that the gauge only just drops through with its own weight. The first hole is then drilled, bored and reamered while the work is held in this position, after which the clamps which hold it are released and it is slid along in contact with the guide strip till it abuts against the other stop. It is now in position for drilling the other hole, but just to guard against error, it is advisable to try the gauge in at the other side before carrying out the operation. The necessity for shifting the stops only arises if the length of the work varies, and thus the two pairs of cross-bars can be drilled at two settings of the stops. Fig. 5 shows this method of setting up.

The holes in the slide frame cross bars should be finished to a light driving fit on the slide bars, and those in the capstan slide cross-bars to a push fit. If the available reamer is of such a size that it produces a hole of the required size for the former, it will obviously leave the latter too small, in which case the holes may be lapped out after reamering. Conversely, it may be found undesirable to pass the reamer right through the holes in the former pair of bars.

It will also be noted that the holes in the capstan slide cross-bars must be slightly below the centre line (this is not shown in the detail drawings), to provide clearance over the lathe bed when they are fitted to the slide bars. This can be allowed for in marking out the centres of the holes, and the guide strip on the faceplate adjusted to suit, when they are set up for drilling. A simpler method, however, is to leave the guide strip in place, and interpose a thin strip of packing (say between 20 and 24 gauge) between the bar and the strip.

The drilling of the other holes in the two sets of cross-bars may be left to a later stage in the construction ; the tapped holes in the capstan slide bars, for instance, may conveniently be spotted through from the holes in the slide plate, and those for the pins or grub screws which secure the slide bars to the slide frame cross-bars may be drilled when the frame is finally assembled. When carrying out this operation, it is most important that the frame should be quite square before drilling holes, and that the two bars should rest truly on the lathe bed, or other flat surface, without any suspicion of twist.

(To be continued)

The "Pittler" Lathe

(Continued from page 310)

refer to the centre of the worm wheel, and are then matched with a worm of 5 t.p.i. on a pitch diameter of 1 5/16 in. and a blank diameter of 1 7/16 in., 3 " thou." full. The nearest diametral pitch is 16, which would have to have a wheel 1/16 in. less in pitch diameter, but could not have the worm cut more nearly accurately than with an error of 4 thou. per pitch.

In a conclusion of these notes following, the suggested values of the toothed and worm gears of the $3\frac{1}{2}$ in. lathe will be given, unless positive information relating to an actual example comes to hand.

Referring to Fig. 27 it will be noticed that the division plate *D* is adjustably fixed to an extension of the bracket bearing, and an arrangement of the index arm and spring index, with counting sector, will be given in the conclusion, which gear is a duplicate of that on the head dividing spindle.

It only remains here to point out that the cone pulley, in one with its pinion, runs free on an extension of the pivot shaft, to which position it is kept in gear line by a loose collar on the shaft extremity shown dotted. This is about all that can be written for the moment, and it is pointed out that most general dimensions as applied to the $3\frac{1}{2}$ in. lathe can be scaled off the illustration by measuring such dimensions with a rule and adding half as much again to the reading. All main dimensions will be given apart from this.

(To be concluded)

An Adjustable Driver Pin

By Wm. Cleghorn

THE following description is of an easily made addition to the lathe which does away with the "messing about" connected with the use of odd bolts or stud-iron and washers when the regular driver pin is found to be too long or too short for the job in hand.

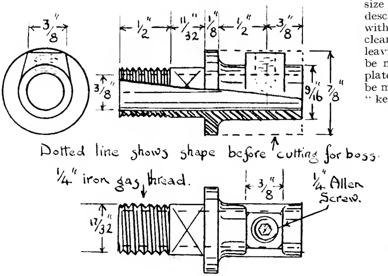
It takes only a short time to make, yet the writer was several years "going to make it," until, finally, being fed up with extemporising when turning overhung cranks or levers at the ends of spindles, the job was tackled and has since proved a success.

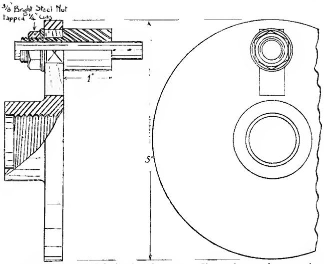
When the above mentioned cranks, etc., are being turned and a long and usually small diameter bolt is being used for driver pin, it will be found that the bolt will be most inclined to bend and slip just at the critical moment, as for instance right in the middle of the thread when screw-cutting.

We have all seen the lathe-maker's advertisements, which say "adjustable driver," but those drivers are, as a rule, adjustable in only one direction, i.e., radially, and a pin that combines both radial and length adjustments will be of much more value.

The main objective sought when designing the pin, was to have the body of the driver and its locking nut small enough to give the maximum travel in the slot of the driver-plate, and at the same time to retain sufficient strength and rigidity for all ordinary work. To this end, the extending portion, which is consequently the most likely to bend, was obtained. Having fixed upon 3/8 in. bright mild steel as being the smallest allowable, it was next found that the sleeve in which the pin had to slide could be made 17/32 in. outside and could be screwed 1/4 in. iron gas without serious weakening, and that the smallest available standard nut would be 3/8 in. Whitworth, which just taps out nicely to 1/4 in. iron gas.

The part of the body or sleeve which slides along the slot was made 17/32 in. square, the length of the squared portion being left slightly under the thickness of the plate to allow clearance for tightening. This square ensures that only one spanner will be required when adjusting. Having to use two spanners to one bolt is always an annoyance.





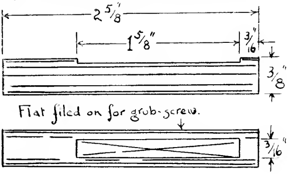
The screw which locks the extending pin at the required spot may be either a hex-headed pinching pin or a grub screw. The writer prefers the latter, as it takes up less room, looks tidier and is also less dangerous in moving machinery.

The body may be left either plain parallel, as shown in the sketch of complete driver, or it may be turned and filed to the shape shown in the detail sketch. This does not take long to do and it makes a much lighter and a neater job, and it will be found easier if the small grub-screw boss is left square as shown. When fitted into the driver plate, the boss should be at the back when the driver is on "top centre" so that it will not interfere with the tail of a carrier used close up and will be less likely to catch in one's sleeve when filing.

Where a face-plate is used for driver-plate, one of the slots can easily be filed out to take the body; it would hardly do to reduce the body itself any further, and in any case it could not be done without damage to the thread.

When making articles such as this, i.e., with a long and fairly small bore, it will be found an advantage to bore and ream the hole first with the work held in the chuck, and then to complete the outside turning with the job running on its bore, between the centres. This ensures concentricity of outside with inside, dependent, of course, upon the truth of the live centre.

The length of the extending piece will depend upon the size of the particular lathe for which it is made. The one described was made 2 5/8 in. long and when pushed in flush with the body, i.e., its shortest position, the other end just clears the headstock bearing. At the other extreme, leaving sufficient pin in the body to make it secure, it can be made to project about 2 3/4 in. from the surface of the plate. Whenever they are required, longer pins can easily be made in a few minutes, as all they require is a small flat "keyway" filing on for the grub-screw to bear upon.



An Improved Cross Slide

Alterations to a lathe to obtain a longer traverse

By L. Powell

THE following is a description of alterations carried out on the cross slide of any $3\frac{1}{8}$ in. Myford standard model so as to increase the traverse from $3\frac{1}{4}$ in. to approx. 5 in. Although the drawings reproduced apply only to the above-named lathe, a similar alteration could be carried out on a number of makes of lathes with the various items made to suit.

To obtain this extra traverse, advantage is taken of the fact that the forward traverse is limited by the plate which secures the feed screw coming in contact with the fixed slides on the saddle. A new mounting is, therefore, made to overcome this and give extra forward traverse ; see Fig. 1, which shows the cross slide wound to its new forward position.

Advantages to be gained by the alteration are as follows :

(1) Large diameters may be faced across without having to move the tool post.

(2) A good length may be milled when bolted to the cross slide table.

(3) An extra tool post may be fitted to operate at the rear of the job (tool upside down, of course). This is very convenient for mounting a parting tool, as it enables a facing tool to be used in the normal way, and the parting tool brought into operation without having to change tools. This method us used on production machines.

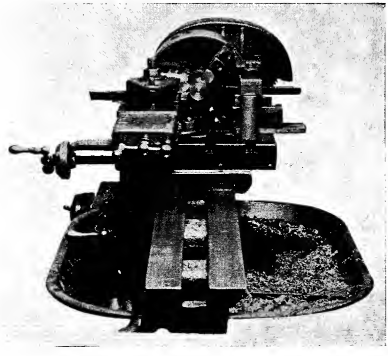
The only new parts required are the mounting bracket, Fig. 2, and the longer feed screw, Fig. 3 ; but advantage was taken, whilst making the new screw, to accommodate a micrometer collar, as is shown at Fig. 4.

The first item to tackle is the new screw, Fig. 3. This is made from a piece of $\frac{3}{8}$-in. dia. M.S. rod, and is fully dimensioned on the drawing. But I would suggest that, before screw-cutting, the existing feed screw is dismantled and checked up for size so that the new screw can be made identical for screw size ; it is essential that the screw should be a good fit in the nut, with no slack. The rod will, of course, be run between centres for screw-cutting, and for those who have had little experience in screw-cutting, I recommend they study the " M. E." Series Handbook, " Screw Cutting," which gives full details for cutting all types of threads. The $\frac{1}{4}$-in. dia. plain portion must be turned to provide a good running fit in the $\frac{1}{4}$-in. dia. reamed hole in the mounting bracket, Fig. 2.

Fig. 4, the micrometer collar, is turned from a piece of $1\frac{3}{4}$ in. dia. M.S. or brass bar. This is held in the self-centring chuck, faced off true end counter-bored as shown ; at this same setting, it is drilled and tapped $\frac{1}{4}$ in. B.S.F. It can now be parted off to the required width. The rest of the work on this part is best done on a stub mandrel. For this, take a piece of $\frac{3}{8}$ in. dia. M.S. bar held in the three-jaw, with about 2 in. projecting ; turn down about 1 in. and screw $\frac{1}{4}$ in. B.S.F. ; undercut the last thread or so and form a shoulder ; now screw on our partly-made collar, with the recessed side to the chuck, when it can be finished machining.

The next operation is to divide the collar and scribe on it the divisions. This is done with a sharp-pointed tool in the tool-post, traversed along by hand, the dividing being done with a change wheel on the other end of the mandrel.

It will be seen that the screw is 12 t.p.i., and this will not divide up into an even number of divisions to give thousandths of an inch ; 83 divisions would be the nearest, but it is unlikely that an 83-tooth change wheel would be available, so I suggest a 55-tooth wheel used as a master, and the collar marked with 55 divisions, when each one will represent a movement of the tool of 0.00151 in., or nearly three thousandths on the dia. of any work operated upon.



The modified Myford lathe, shown set up with an improvised tool post at the rear carrying a parting tool, whilst the normal tool post carries a front facing tool.

The collar now only requires engraving or stamping with numbers, say, at every 4 divisions, i.e., numbered 6-12-18, etc.

Fig. 2 shows the new bracket ; this is made from $\frac{1}{4}$-in. thick bright M.S., and is made in two parts and welded. The base-plate may be made from the existing plate on the lathe, provided it is cut away to clear the fixed slides on the saddle. Care must be taken when drilling the hole for the leadscrew, and this should be marked off with the bracket bolted in position to ensure that it lines up with the lead-screw nut.

The parts are now ready for assembly, and there is no special point to mention here if the drawing Fig. 1 is studied.

A small pointer is attached to the bracket to enable the divisions to be read off.

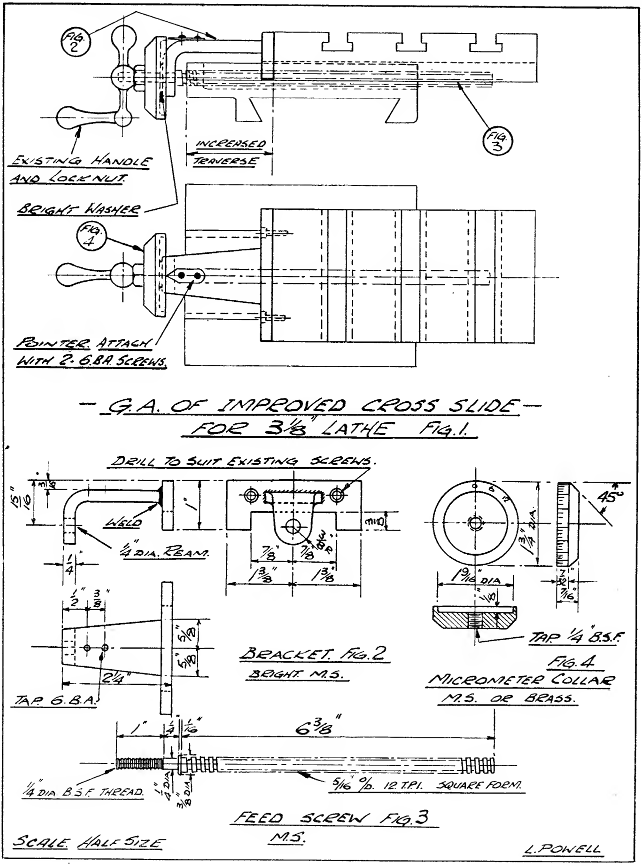
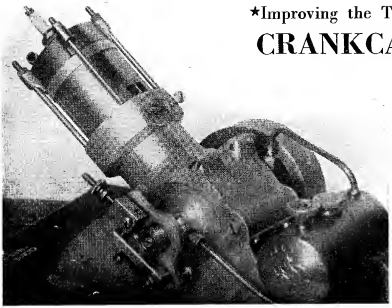


FIG. 2
FIG. 3
INCREASED TRAVERSE
EXISTING HANDLE AND LOCK NUT.
BRIGHT WASHER
FIG. 4
POINTER. ATTACH WITH 2-6.B.A. SCREWS.
- G.A. OF IMPROVED CROSS SLIDE -
FOR 3 1/8" LATHE FIG. 1.
DRILL TO SUIT EXISTING SCREWS.
15/16"
3/16
1"
WELD
1/4" DIA. REAM.
1/4"
7/8"
7/8"
1 3/8"
1 3/8"
1/2"
3/8"
5/8"
5/8"
2 1/4"
TAP 6.B.A.
BRACKET. FIG. 2
BRIGHT M.S.
45°
1 3/4" DIA.
1 9/16" DIA
1/16"
7/32"
7/16"
TAP 1/4" B.S.F.
FIG. 4
MICROMETER COLLAR
M.S. OR BRASS.
1"
1/4"
1/16"
6 3/8"
1/4" DIA B.S.F. THREAD.
1/4" DIA
3/8" DIA
5/16" O/D. 12 T.P.I. SQUARE FORM.
FEED SCREW FIG. 3
M.S.
SCALE HALF SIZE
L. POWELL



A "flat-top" 15 c.c. two-stroke engine constructed by Mr. P. Ribbeck, of Glasgow, in which special means of increasing crankcase displacement are incorporated.

★Improving the Two-Stroke

CRANKCASE COMPRESSION

Some suggestions for interesting and profitable experiments in model I.C. engine design

By Edgar T. Westbury

OUR recent discussions on various features of design have dealt very little, if at all, with matters which concern the functional operation of the engine, but have concentrated almost entirely on mechanical details. In any attempt to improve design, it is necessary to take great pains to co-ordinate both sides of design, as one cannot make true progress without the other. So many designers, however, attempt to improve functional design without worrying their heads about mechanical design, that I have thought it advisable to emphasise the importance of the latter, and the folly of taking anything for granted in the few components which make up the simple mechanical system of the two-stroke engine. It is, however, by no means a simple matter to deal with problems of functional design, because they involve principles and conditions which can only be investigated indirectly. That is to say, errors in functional design only manifest themselves by symptoms, which are not always specific to any particular cause, and even the most experienced investigators may find it extremely difficult to know just what is causing the particular symptoms. That is the principal reason why two-stroke engines are so difficult to investigate in a logical manner, and are often the despair of those who attempt to develop them; it also explains why the two-stroke is so whole-heartedly hated by many engineers, because the majority of people generally develop a grudge against anything which defies their understanding. But this attitude is not a truly logical one, and even though we may waste time in investigating false clues, we are not justified in throwing up the problem in despair, or condemning the engine as a complete bag of cussedness. I know several readers who have dropped promising experiments in two-stroke design in the past because they didn't seem to be progressing at a sufficiently rapid rate; but everyone who has ever been engaged in serious research work will agree that results nearly always come when one least expects them, and that it is futile to expect certain results in a set time.

* *Continued from page* 277, "*M.E.*," *April* 3, 1941.

The matter of crankcase compression is, in my opinion and experience, one of the least understood factors in two-stroke design; and it involves problems which are all the more difficult because so many people regard them as simple and direct. Let us therefore approach these problems by considering just what it is that we seek to accomplish in this very essential process of crankcase compression, before attempting to decide how we are going to do it.

The limitations of the two-stroke engine in respect of volumetric efficiency, as discussed early in these notes, are, I think, generally agreed upon, and it is also beyond question that improving volumetric efficiency is one of the most logical methods of increasing engine performance. But among the things that are by no means so universally understood about this problem are: (1) that the measures taken to improve volumetric efficiency often fail to accomplish their object; (2) that they not infrequently increase mechanical and other losses; and (3) that the mere fact of increasing the volumetric efficiency of the crankcase does not necessarily result in an increase of the power actually developed in the cylinder.

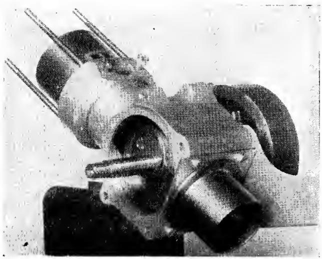
Most designers who wish to obtain the best possible volumetric efficiency from an engine start by reducing the clearance space in the crankcase to the very lowest possible limit—in some cases they even go so far as to skimp the mechanical design to a really dangerous extent to do so. The great majority of engine designers would agree without hesitation that this is a logical and sure method of accomplishing the desired object, but in actual fact, it is only correct in cases where other factors of design are properly co-ordinated to suit. By way of evidence, I have known several engines in which measures taken to reduce crankcase clearance have either resulted in no improvement at all, or even in an actual reduction in the measured volumetric efficiency. (Incidentally, although I do not propose to deal with methods of testing volumetric efficiency at present, it is by no means difficult to do this on the test bench.)

Why Crankcase Compression is Necessary

In case this seems to be too obvious to call for detailed explanation, let me say at once that *compression*, as such, is quite definitely *unnecessary*, in fact, it is a rather troublesome by-product of the essential process of displacement, which is the really important function of the crankcase, or other form of pump, which is used to supply the mixture to a two-stroke engine. We have to forcibly feed a two-stroke engine with mixture because it is normally unable to feed itself, and some form of pump is thus the only alternative to devoting a complete stroke of the working piston to this function. Now, leaving out of the question true forced induction, or "supercharging," all we wish to do is to fill

the cylinder completely with mixture at the commencement of the compression stroke, and the need for raising its pressure does not arise. Unfortunately, however, it is impossible to move or " displace " air at any appreciable rate without altering its pressure, and thus any device used for this purpose must necessarily compress the air to some extent—a fact which explains why the terms pump, compressor and blower are always a little indefinite, and why their functions are bound to overlap. But any work applied to changing the pressure and volume of the mixture is a dead loss, since it performs no useful function in the working cycle of the engine.

It should be clearly understood that the clearance volume, or " dead space," in a pump has no effect whatever on its volumetric efficiency, except in so far as it affects



Mr. Ribbeck's engine with bearing housing removed, showing displacer cylinder and one of the eccentrics for driving displacer piston.

changes of pressure. If it were possible to displace air or gaseous fluid without any change of pressure, the pump would attain 100 per cent. volumetric efficiency, irrespective of the amount of clearance space in its cylinder. This fact can be demonstrated experimentally, and something closely approaching these conditions *might* be attained in the charging system of an engine—if only we were not in such a tearing hurry about the business !

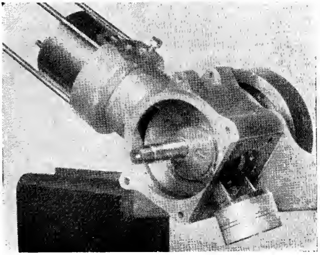
In an engine required to run at high speed, the amount of time which can be allowed for charging the cylinder is very small indeed, and therefore, in order to get the mixture into the cylinder, pressure must be applied to it to increase its rate of motion. That is why it becomes necessary to reduce crankcase space to the lowest amount—and even when we have done everything possible, we can hardly pretend that the crankcase is a very efficient pump. For one thing, the usual method of controlling the admission and delivery of mixture to the crankcase by means of piston-controlled ports does not permit of efficient timing, and even if this fault could be compensated by making the ports infinitely large, it is still necessary to expend a lot of useless power in creating a partial vacuum before the opening of the admission port, and building up a pressure before the opening of the delivery (actually the transfer) port. Let it be clearly understood that these changes of pressure, or " pumping losses," show up clearly on the debit side of the mechanical efficiency account, and thus the greater they are, the lower the mechanical efficiency.

In cases where the cylinder is fed directly from the displacement chamber, as it is in the normal two-stroke, it will be quite clear that the pressure of the gas will be falling throughout the transfer period, and thus it is practically impossible to transfer the entire volume of the charge. This fault is often made worse by the necessity of closing the transfer port early ; but it may be mitigated in a well-designed engine by the effect of gas momentum, which tends to keep the mixture flowing, after the initial pressure which set it in motion has been lost. The importance of port and passage design is thus emphasised.

Some years ago I was engaged on some experiments with a stationary engine of the stepped-piston type, in which volumetric efficiency was rather poor, in spite of the efficiency of the displacement pump. I succeeded in tracing the fault to the port timing, and demonstrated that, by mechanically controlling the pump valves to reduce pressure changes, the engine would run just as efficiently on a much lower charging pressure. This feature, like many another logical improvement, was not adopted by the makers of the engine because it increased the cost of construction, but it clearly showed that high compression of the charge previous to its admission to the cylinder, is not in itself a desirable feature.

I make it a rule to take all reasonable measures to ensure compactness of the crankcase in all my small engines, but I have not usually found it desirable to go to extraordinary lengths, such as filling up the inside of the piston or building up odd protuberances in the crankcase in order to save the last fraction of a cubic inch. At the same time, I am fully aware that other designers believe in these measures, and in some cases succeed in backing up their beliefs by concrete evidence of high performance. The example of M. Suzor's remarkable little engine, as fitted to his racing boat, *Canard*, which made model speed-boat history way' back in 1924, is shown here (Fig. 55) to illustrate the extent to which clearance space can be cut down.

One very important disadvantage which may result from



The engine further dismantled, the displacer cylinder being removed to show piston and eccentric-rods.

meticulous observance of these measures, however, is that tortuous or partially obstructed air passages may be produced, and thus, in spite of the increased charging pressure, the transfer of mixture may actually be retarded ; this will, of course, be more serious as the speed of the engine is increased. I have generally found it more profitable to consider ways and means of cleaning up port and passage design than methods of boosting up pressure, especially as any gain produced by the former is clear profit, and is not offset by any reduction in mechanical efficiency.

Although it is by no means impossible to design the piston of an engine so as to avoid leaving a large cavity in the underside, I regard any method of attempting to reduce the volume of the cavity, in the normal type of piston, as a dubious or even dangerous measure. If solid pieces of metal are attached to the piston, they necessarily increase the weight, and interfere with balance. Hollow pieces are extremely difficult to fit properly, and the air spaces which they enclose form an insulating layer which seriously retards the transmission of heat from the upper to the under side. They may thus limit the ability of the engine to maintain internal cooling at high power output. And no matter how such pieces are fixed to the piston, there is an unavoidable risk of their becoming detached at high speed and causing a major catastrophe.

In cases where an existing engine is being tuned up to increase power output, any alteration of crankcase volume will produce certain effects in the power and running characteristics, and these should be carefully noted, as they provide clues as to whether the change is leading in the right direction. Sometimes the most noticeable effect of increasing crankcase compression is to narrow the carburation range and increase the liability to four-stroke. In this case it is probable that the transfer port is opening late, or that the passage or the piston deflector are not of the best shape to deal with the increased pressure. It is clear that an increase in crankcase pressure should logically call for earlier transfer port opening, but this in turn generally involves the need for earlier opening of the exhaust. Most experimenters are naturally reluctant to tinker too much with port openings on an engine known to be fairly efficient, as it is much easier to ruin an engine than to " hot one up " in this way; all such alterations, therefore, should be approached very cautiously. If an engine develops a tendency to violent blowback at the admission port when the crankcase volume is reduced, it is obvious that this cannot be cured by increasing the depth of the port, and the only practical method of reducing its depth would be to fit a new piston with slightly greater length of skirt. Generally, however, it is possible to reduce blowback by careful attention to the induction passage design. It is sometimes possible to use a smaller choke tube without loss of power in such cases, as the reduced crankcase volume results in producing a more powerful suction at the inlet port.

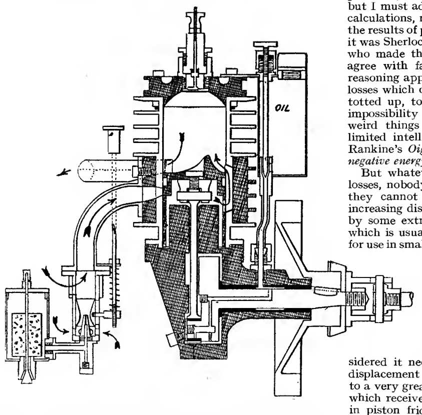


Fig. 56. The engine of M. Suzor's *Canard*, showing the measures taken to reduce to the utmost limit the unswept volume of the crankcase. (From Vol. LIII of " The Model Engineer".)

Increasing Crankcase Displacement

It will be noted that none of the measures discussed above for improving crankcase efficiency can possibly do more than assist in handling more effectively the limited amount of mixture displaced by the underside of the piston. In a 30 c.c. engine, for instance, either side of the piston displaces a volume of 30 cubic centimetres, and thus it is obvious that after inevitable losses are allowed for, the quantity of mixture displaced in the crankcase and transferred to the cylinder must always be less than the latter would normally hold at atmospheric pressure. Some writers on this subject have gone to the lengths of calculating just what the percentage of volume loss will be under certain conditions, but I must admit that I have a profound mistrust of these calculations, mainly because they do not seem to tally with the results of practical tests. I am not quite certain whether it was Sherlock Holmes (or rather his creator, Conan Doyle) who made the observation that a theory which does not agree with facts is untenable, but whoever said it, the reasoning appears pretty sound to me. I have seen all the losses which occur in two-strokes very ably calculated and totted up, to such marvellous effect that they prove the impossibility of such an engine working at all ! One hears weird things about cold heat and black light, but my limited intelligence refuses to assimilate the idea of Mr. Rankine's *Oigh Alba* doing 40 m.p.h. round the pole on *negative energy* !

But whatever may be the actual extent of volumetric losses, nobody will deny that they are there all right, and they cannot be eliminated except by some method of increasing displacement volume, either in the crankcase, or by some extra pump or blower. Apart from the latter, which is usually considered too complicated and elaborate for use in small engines, several devices have been introduced with a view to increasing crankcase displacement, without adding materially to the number of parts in the engine, or complicating its construction.

One of the best known of such devices is the stepped piston, which was popularised some years ago in the Dunelt motor-cycle. The arrangement and operation of this piston is so well known that I have not considered it necessary to illustrate it here. It enables the displacement of the underside of the piston to be increased to a very great extent over that of the portion of the piston which receives the power thrust, with little or no increase in piston friction, and no other disadvantages beyond a somewhat increased reciprocating weight.

On the face of things, this method seems to be an obvious improvement, but although the Dunelt, and some other engines which have adopted it, have undoubtedly established a claim to recognition, there is not, so far as I am aware, any concrete evidence of their definite superiority over normal types of engines in respect of volumetric efficiency. It would not, however, be a very difficult matter to make comparative tests of engines, with and without stepped pistons, so as to settle the matter. But, as already hinted, it does not inevitably follow that

just because more mixture is pumped into the power cylinder, more power will be got out of it. Many experienced designers have expressed the opinion that attempting to put more mixture into the cylinder of an ordinary two-stroke engine is simply futile, since it will promptly be blown out of the exhaust port; and there is a certain amount of evidence to support this contention, at least in respect of the existing examples and applications of commercial two-stroke engines. In the case of an engine developed specially for high power putput and speed, however, there may be justification for abnormal fuel wastage, if it enables the volumetric efficiency to be maintained at high r.p.m.

Another method of increasing displacement is by means of an extra blower piston fitted to the crankcase, to augment or "boost" the displacement of the normal piston. This method has been employed with some success in motor-cycle racing practice by some Continental designers, and I am able to illustrate its application to model practice in an engine constructed by Mr. P. Ribbeck, of Glasgow. It will be seen that the blower cylinder is attached to what would normally be the bottom of the crankcase, that is, opposite to the main cylinder, though the engine is in this case mounted obliquely, in order to enable the height of the shaft to be kept as low as possible. The end of the blower piston is open, as the inner side of the piston is employed for displacement, and the latter is driven from the crankshaft by means of two eccentrics attached to the crank cheeks. The piston does not move in opposition to the main piston, but is timed so that the maximum rate of crankcase displacement occurs during the port opening periods.

I am unable to give any particulars of the performance of this interesting little engine, because although Mr. Ribbeck has very kindly submitted it for my inspection, and also given me permission to try it out, circumstances have so far prevented me from doing so. It may be remarked, however, that while this method has some potential advantages over the stepped piston in respect of balancing, as the blower piston can be employed to assist balance of the main working parts, it introduces increased piston friction and a greater number of working parts.

Experiments in engine design such as this are often less successful than they deserve to be, for the simple reason that in departing from the beaten track, they encounter uncharted territory, and thus their practical progress may be held up by comparatively small obstacles and side issues. The world, and especially the racing or competitive world, judges the success of a design purely by immediate results, and thus it usually happens that more credit is obtained for treading well-defined paths of development than for the most intrepid feats of pioneering. But the pioneer should console himself with the thought that, while he may cover much less distance than the traveller on the high road, he certainly has a more interesting and eventful journey!

(To be continued)

Letters

Lathe Design

DEAR SIR,—Mr. Clift's letter should, I think, open up a profitable ventilation of views on small home workshop lathes, and I would like to suggest improvements in headstocks.

Lathes for the home workshop seem to fall between $3\frac{1}{2}$-in. and $4\frac{1}{2}$-in. centres and appear to be scaled down from the larger 6-in. or 8-in. sizes in all dimensions for the sake of outline, and by this process we arrive at the inevitable No. 1 morse-taper complex.

These weak spindles, with "out-of-scale" overhanging chucks are, I think, the root cause of our wobbling, chattering and parting-off troubles, and I would like to see a more massive headstock with a stiff mandrel, taking $\frac{5}{8}$-in. bar stock through the hole instead of only $\frac{3}{8}$-in., and fitted with No. 2 M.T. centre.

We could then use the commercial series of collet chucks with No. 2 M.T. as used on milling machines for end-mills and part off close to the support, itself much stiffer.

I realize that a 6-in. centre class of headstock on a 4-in. centre class of lathe would appear out of scale, but it would be a more practical tool.

By the way, I still have, in occasional use, a Drummond 4-in. round bed, bought second-hand in 1913—No. A 4601. Has any reader an older one?

Yours faithfully,

Bromsgrove. A. BARHAM.

[This, and several other letters we have received on this subject of Lathe Design, would seem to indicate that many readers overlook a very important factor in the matter. Obviously, many of the "improvements" mentioned by correspondents could be easily made; but the idea gives rise to several questions: How many *model engineers* really require a lathe that would stand up to mass production methods? How many *model engineers* would be prepared to pay for such tools? And is not the implied method of using a lathe to its utmost capacity every time it is operated, rather against the true policy of most model engineers?—Ed., "M.E."]

Hot-air Engines

DEAR SIR,—It is some time since "Artificer's" interesting series of articles on Hot-air Engines came to a close, but I hope that interest in the subject has not yet vanished.

Looking back to my prep. school in 1897, I remember that our house water supply was kept up by a very big Robinson hot-air engine—one horse-power we were then informed. It certainly was a very big engine with a chain drive to the pump crankshaft. I used to haunt that engine shed, though it was strictly out of bounds, naturally. I can well remember the big green cylinder, pleasantly warm and oily, the trickle of the circulating water, the bright-red linkwork and the curious little snifting-valve at the back, whose object I could not then fathom. My great joy was to be present when the engine was started up. If the fire had only been going for a short time, the engine would make a fine start, only come to an ignominious standstill when the water rose in the tank supply pipe. On the other hand, if the engine was really hot, after a hefty heave from the gardener, it would start up with a roar and that unhappy man would have to lean heavily against the flywheel to restrain its ardour until the pump had got to work.

Normally it ran for hours without attention, but there were occasionally thrilling moments when the chain came off. At other times if the fire had been well and truly stoked and the engine in good form, the combined efforts of the gardener and his boy to grab the flywheel and stop the engine, availed nothing. The engine, left running, was locked up in disgrace.

It was a big defect in the Stirling engine that they had no throttle control of any sort; I met the same trouble when trying to use a Henrici hot-air engine to drive a small lathe. It raced wildly between cuts.

For the price of a cwt. or so of coal per week this engine ran year after year, pumping for a house of sixty persons, with no major repairs and only unskilled attendance, so I sometimes wonder what modern prime mover would beat this old engine for economy.

Mr. D. H. Chaddock, in his article in the January 23rd issue, suggests heated compressed air as the medium. It is interesting to note that the Dundee jute factory Stirling-type hot-air engine of 1852 (I think this date is correct), of 40

horse-power, ran on compressed air. The description that I had of this engine states that air was compressed to 150 lb., which seems rather high for those days. The drawing shows that the engine resembled an old-fashioned beam engine with a double-acting cylinder. There was a small auxiliary beam at the cylinder end of the main beam, and each end of this operated a displacer. Between the working cylinder and the displacer a recuperator was fitted, but I don't think that this would be of the slightest value in a Stirling engine. The engine was stated to be economical and ran for two years, after which the old hot-air engine trouble of burnt displacer cylinders was too much for it and it was condemned.

It was always my intention to fit a tyre valve to the snifter of my Henrici engine, and pump it up with a bicycle pump whilst running, to see what would happen, but the war intervened and the engine is now part of a munition of war.

I was very interested in the indicator diagram P. 27 of the February 23rd issue, and had no idea that the use of compressed air was so effective. I wish I had tried that experiment now. I think that if compressed air is used, the cranks would have to be set at a less angle than 90 degrees. If compressed air is to be used in a Stirling-type engine, it is admitted that the D.A.-type is the only type that promises success, but the difficulty that arises is piston lubrication. This must be ample, but whereas in a petrol or steam engine the surplus oil escapes by the exhaust, in the Stirling engine it would get into the displacer and burn up at the hot end. Very frequent decarbonising would be necessary. Assuming that the displacer is vertical, it might be possible to have the cold end at the bottom and drain off surplus oil occasionally.

In looking over many designs of commercial Stirling engines, I consider many of them have been bad, so I have been amusing myself by designing a "perfect" engine, which I hope to submit to your readers' criticism in due course.

Yours faithfully,
Iceland. H. E. RENDALL.

Pump Troubles

DEAR SIR,—*Re* "Another Feed Pump Problem," by H. J. Turpin, it is evident by sketch and description that this is two distinctly separate pumps totally independent of one another, except for the common delivery; therefore, there is no practical reason why they should not deliver, running light, or against any reasonable head. Incidentally, no head pressure is mentioned, but may I suggest that an air chamber or bottle be included, placed as close to the pump as possible, made from, say, cycle tubing, about $1\frac{1}{2}$ in. diameter, 4 in. long, with blanks brazed in, the bottom blank tapped and fitted with a T connected with the rising main, and kept vertical (as an experiment).

Yours faithfully,
"PUMPING ENGINEER."

DEAR SIR,—Mr. Turpin's article on his feed pump troubles attracted my attention, and as he seems to invite some criticism as to how and why this pump fails to function, I feel tempted to help, as from the drawing I would venture to say that the pump has all the bad features, almost, that it could have. First, the plungers give the maximum space for air bubbles, and a ram pump should have the minimum of bottom clearance and a solid plunger so that the maximum squeeze may be had at the end of the stroke, otherwise a good vacuum will not be obtained during the suction stroke. Next, I assume the pump is intended to travel at high speed; can the water get through the suction valves at high speed? The ball suction-valves may, even when lifted, reseat themselves and block the inlet completely. The plunger being $\frac{1}{4}$ in. must surely have a free and easy supply. The speed at which water can be discharged from a pump depends mainly on the power behind the ram, any undue restriction will send up the pressure and a mechanical breakdown will ensue. On the other hand, the speed at which water will flow into a pump depends on the vacuum produced on the suction stroke and the size of the inlet. In view of my experience with pumps in actual practice, I would suggest to speed-boat men to cut down your pump speed, even if you have to increase the size of the ram and fit an air vessel on the discharge side, immediately beyond the discharge valves. This would even out any impulse. And in conclusion, I might say that the main troubles encountered by Mr. Turpin are probably due to the hollow plungers and restricted inlet and a collapsible rubber suction pipe, as the pump suction appears to be designed to take such a pipe. The main point to remember about a feed pump is that water taken in *must* go out, and, provided the pump is mechanically efficient, it will go out.

Yours faithfully,
O.A.S. P. IVISON.

Clubs

Leeds Model Railway and Engineering Society

On March the 30th, Mr. G. Kilburn came along and gave us a cinema show, showing the progress of the steam engine and railway from the time of the *Rocket* to the present day; also films of a railway tour in Italy taken by himself; a tour by caravan followed. All these films were much appreciated by the members. Our next meeting will be held on April 20th, when Running Models is the subject, so will members please bring their models along and make the morning a success.

Meeting place: Mr. Cook's, Kidacre Street, Leeds.

Hon. Secretary, H. E. STAINTHORPE, 151, Ring Road, Farnley, Leeds.

The West Midlands Model Engineering Society (Wolverhampton Branch)

The next meeting of the above Society will be held at the "Red Lion" Hotel, Snow Hill. on Wednesday, April 23rd, at 7.30 prompt. The business of the evening will be our forthcoming exhibition for the benefit of the Soldiers' comforts fund. Visitors are cordially welcomed.

Hon. Secretary, F. J. WEDGE, 13, Holly Grove, Penn Fields, Wolverhampton.

The Junior Institution of Engineers

The Council of the Junior Institution of Engineers has decided to resume the Friday evening meetings, but restrict the time from 6 to 8 p.m.

Friday, 18th April, 1941, at 39 Victoria Street, S.W.1, at 6.0 p.m. Ordinary meeting. Paper: "Fittings and their effect on the Efficiency of Supply Lines," by S. J. Moore (Associate Member and Durham Bursar).

Friday, 18th April, 1941, at the Sheffield Metallurgical Club, West Street, Sheffield, Sheffield Section, when Mr. A. V. Jobling (Member) will open a discussion evening. Time 6.30-8.0 p.m.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks. Annual Subscription, £1 10s., post free, to all parts of the world

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